

Evaluating the Personal Protective Equipment and Surgical Hand-Washing Knowledge Levels of Nursing Students in the Preoperative Period

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Abstract

BACKGROUND/AIMS: Nurses are health professionals who have direct contact with the patient and play an important role in the prevention of healthcare-associated infections. This study was conducted with the aim of evaluating the personal protective equipment (PPE) and surgical hand-washing (SHW) knowledge levels of nursing students in the preoperative period.

MATERIALS AND METHODS: This descriptive and cross-sectional study included 122 nursing students who were studying in North Cyprus. The data of the study were collected in April, 2019 using the PPE (20 questions) and SHW (20 questions) information form (8 questions) which consist of 48 questions in total. Statistical comparisons were made using the Mann-Whitney U test, the Kruskal-Wallis test and the Pearson correlation test. A p-value of <0.05 was considered statistically significant.

RESULTS: Class 2 and 3 had the same amount of the students (61 students in each class). 91.8% of the students had graduated from standard high schools and 122 (100%) of the students had received isolation methods in the courses in their curriculum. The mean total score of the female students was 68.8 ± 8.79 points and the mean total score of the class three students was 68.7 ± 9.72 from the PPE and SHW information form. Students received 67.41 ± 9.44 points from both of the sub-dimensions of the PPE and SHW Form. Correlation levels of PPE and SHW were found to be of a medium level correlation for the average of the total score of the data form ($r=0.418$ $p=0.00$).

CONCLUSION: According to the results of this study, they showed that the student nurses have a medium level of information regarding the PPE and SHW information form.

Keywords: Knowledge, preoperative period, personal protective equipment, hand disinfection

INTRODUCTION

Nurses are health professionals who have direct contact with the patient and play an important role in the prevention of healthcare-associated infections (HAIs).^{1,2} HAIs, which pose a great risk for both patients and healthcare workers, are also a potential danger for healthcare students who will be the healthcare professionals of the future.³⁻⁵ Nursing education consists of theoretical and practical training. Practical

trainings are carried out in clinical areas and laboratory environments and aim to provide skills to the students via these trainings.^{2,6}

Nursing department students can mitigate the risks of infection by knowing the ultimate principles, by using standard precautions, by providing effective care, and by using healthcare services.^{7,8} There are important roles and responsibilities in every stage of the preoperative

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preparation process.⁵ Personal protective equipment (PPEs) are a range of equipment which should be worn by health professionals in order to eliminate the risks of infection by preventing the transmission of body fluids from the patient to the employee and *vice versa*.^{9,10} Hand-washing is the process of washing hands with soap and water in order to prevent the transmission of microorganisms between the employee and patients.^{7,14} The purpose of hand-washing and hand hygiene is to remove visible dirt from the hands and to reduce the number of temporary and permanent flora.^{11,12} Nursing department students can prevent the risk of infection by knowing the ultimate principles, by using standard precautions, by providing effective care, and by using healthcare services.^{7,8} There are important roles and responsibilities in every stage of the preoperative preparation process.⁵ Surgical hand antiseptics might be water-based or alcohol-based solutions.¹³ Surgical hand-washing (SHW) involves; wetting the hands and forearms with water, applying an antiseptic solution by using the hands or sponges, and then repeating the process.^{12,15,16} SHW should be performed within 5 minutes if there is visible contamination, and within 3 minutes if there is no contamination.^{7,14,16} Following the hand antisepsis process, the team members prepare for surgery by putting on sterile gloves which serve as a barrier between the surgical staff and the patient.^{3,11} Nurses should have the knowledge and competence to be able to use PPEs and SHW procedures in order to protect both themselves and their clients' health.^{1,9}

Research Questions

1. Is there a difference between the descriptive characteristics of the nursing students and the information scores on the use of PPE?
2. Is there a difference between the nursing students' descriptive characteristics data and their SHW usage information scores?
3. Is there a difference between the nursing students' descriptive characteristics data and their PPE and SHW total knowledge scores?

MATERIALS AND METHODS

This study was conducted in accordance with a descriptive and cross-sectional design. The population of this study consisted of 160 nursing students in their third (n=77) and fourth (n=83) class in the nursing department of a university in North Cyprus. Thirty-eight students who did not attend the course, refused to participate in this study or had participated in the pre-application were excluded from this study and so this research was completed with 122 students. The "PPE and SHW information form" which was created by the researchers in accordance with the literature was used in this study.^{2,15-17} This data collection form consists of three parts. In the first part of the form, there are 8 questions about the descriptive characteristics of the students (age, gender, the school that was previously completed, the class they studied in, etc.). In the second part of the form, there are 20 items for determining the levels of use of PPE and in the third part of the form, there are 20 items regarding their SHW knowledge levels. All necessary information about this study was given to the students before they agreed to participate. After obtaining all necessary permissions, the data were collected from the students in a classroom setting on the day that students had a basic professional nursing courses. Forty items including the information questions were prepared. The students were asked to answer the items by selecting one of "True", "False" or "Don't Know." The correct answers were given 2.5 points for a maximum total of 100 points. Higher scores indicate that the students have a better level of knowledge. In order to evaluate the information form in terms of subject scope adequacy,

expert opinions were obtained from 5 faculty members and the final form was created.

In order to determine the comprehensibility of the questions in the data form, a preliminary study was conducted with 10% of the population, i.e. 16 student nurses. Content Validity Index (CVI) was used by taking expert opinions into consideration. CVI; items validity index for items, Item Validity Index (I-CVI) was calculated using the Scale-Content Validity Index (S-CVI) for the whole questionnaire. In this study, S-CVI and I-CVI values were found to be 1.00. The Cronbach's alpha value, which shows the reliability of the questionnaire, was found to be $\alpha=0.78$.

Permission was received from the Scientific Research Publication Ethics Committee, Health Ethics Subcommittee with the project number (approval number: ETK00-2019-0012) as well as from the Eastern Mediterranean University.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences version 18.0 software. All results were expressed as mean \pm standard deviation or percentage. Statistical comparisons were made using the unpaired Mann-Whitney U test, the Kruskal-Wallis test and Pearson's correlation test. A p-value of <0.05 was considered statistically significant.

RESULTS

In this study; 68% of the nursing students were female and their average age was 22.55 ± 1.53 years. 50% of the students were in the third year and 50% were in the fourth year. 91.8% of the students had graduated from high school, 2.5% had graduated from health vocational high schools and 5.7% had graduated from associate degree programs. 100% of the students had received training on the use of PPE and SHW in the preoperative period within the scope of their curriculum (Table 1).

When the most correct answers were taken into consideration about the usage of PPE, 98.4% (n=120) of the students responded correctly to the item of "All jewelry must be completely removed before putting on PPE", for the item "Protective equipment should not be used only in the operating room" it was 96.7% (n=118), and for "Surgical masks should be worn to cover the entire face (mouth, nose, and chin)" it was 95.1% (n=116) of the students who answered correctly. When SHW procedures were examined, the items of "hands should be washed before and after all procedures", it was 95.1% (n=116) and for "Hand-washing should be performed from the fingertips to the elbow", it was 91.8% (n=112) of the students who answered correctly (Table 2).

In addition, the usage of PPE and SHW items' incorrect answers were examined. Regarding incorrect items about the usage of PPE; 86.9% (n=106) of the students incorrectly answered "When removing the surgical mask, the upper ties should be undone first." The item of "the bottom ties of the mask should be tied before the upper ties" was answered incorrectly by the students at a rate of 68.0% (n=83). When SHW procedures were examined, 67.2% (n=82) of the student nurses answered incorrect by responding "Sterile gowns should be put on by holding at the wrist." The item of "washed hands should be kept at the waist level" was answered incorrectly by 59.8% (n=73) of the students and 54.4% (n=52) of the student nurses answered the item incorrectly by stating "The bonnet and mask should not be put on before SHW" (Table 2).

Table 1. Demographic characteristics of the nursing students (n=122)

	n	%
Age		
20-21	21	17.2
22-23	82	67.3
24 or above	19	15.5
	Mean ± SD	
	22.55±1.53	
Gender		
Female	83	68.0
Male	39	32.0
Class		
3 rd year	61	50.0
Senior year	61	50.0
Type of previous school graduated from		
High school	112	91.8
Health vocational high school	3	2.5
Associate	7	5.7
Isolation methods training status		
Yes	122	100.0
Isolation training method		
Courses in the education curriculum	122	100.0

SD: Standard deviation.

The nursing students' mean PPE knowledge score average was 29.6 ± 5.32 , and their SHW knowledge score average was 37.7 ± 5.88 . When the total knowledge scores of the students were examined, it was found that the mean knowledge score was 67.4 ± 9.44 . When the total score ranges of the scales were examined, it was found that the lowest score obtained was 40 and the highest was 85. According to these results, it was concluded that the level of knowledge of nursing students was mid-level/intermediate (Table 3).

When the sociodemographic data of the student nurses were examined, it was observed that the results which made a significant difference were based on gender and class. Therefore, when the sub-dimensions were examined, it was seen that the mean score of the use of PPE for female students (30.2 ± 5.17) was higher than the score of the male students, but there was no significant difference ($p > 0.05$). The mean scores of the 3rd grade students (30.8 ± 5.23) was higher than the 4th grade students and a significant difference was found between the two classes ($p < 0.05$). When the mean scores of SHW was examined, the female students had higher scores (38.6 ± 5.25) than the male students, but it was not statistically significant ($p > 0.05$). The mean scores of the 3rd grade students (37.9 ± 6.31) were found to be higher than the 4th grade students, but there was no significant difference between the classes ($p > 0.05$). When both total dimension scores were examined, the female students scored higher (68.8 ± 9.79) than the male students. The grade point average of the 3rd grade students (68.7 ± 9.72) was found to be higher than the fourth-grade students. There was no statistically significant difference between the two groups ($p > 0.05$) (Table 4). When the relationship between age and PPE and SHW of the nursing students

Table 2. Nursing students' answer to questions related to PPE and SHW (n=122)

A. Recommendations that students answered most correct		True		False	
		n	%	n	%
Personal protective equipment	- Jewelry used must be completely removed before wearing protective equipment	120	98.4	2	1.6
	- Protective equipment should only be used in the operating room preparation process	118	96.7	4	3.3
	- Surgical masks should be worn to cover the entire face (mouth, nose, chin)	116	95.1	6	4.9
	- The metal part of the surgical mask should be firmly placed on the face by pressing on the bridge of the nose	115	94.3	7	5.7
	- Protective equipment is not preventive against possible infections	110	90.2	12	9.8
Surgical hand-washing	- No need to wash hands before and after all procedures	116	95.1	6	4.9
	- The use of nail polish and artificial nails is not important in surgical hand-washing	113	92.6	9	7.4
	- Hand-washing should be carried out from the fingertips to the elbow	112	91.8	10	8.2
	- Do not touch the outside of the apron with bare hands	112	91.8	10	8.2
	- Sterile gloves should be worn over the sterile gown so that the wrists are not exposed	112	91.8	10	8.2
B. Recommendations that students answered most wrong					
Personal protective equipment	- When removing the surgical mask, the upper ties should be undone first	16	13.1	106	86.9
	- The ties of the surgical mask should not be discharged node	30	24.6	92	75.4
	- Bonnets should be removed from the back to the front	33	27.0	89	73.0
	- The lower ties of the surgical mask must be tied first and then the upper ties tied	39	32.0	83	68.0
	- Goggles should be removed with gloved hands	50	41.0	72	59.0
Surgical hand-washing	- The sterile surgical gown should be worn to the wrist	40	32.8	82	67.2
	- Washed hands should be kept at waist level	49	40.2	73	59.8
	- The sterile surgical gown should be taken off before removing sterile gloves	67	54.9	55	45.1
	- While putting on sterile gloves, you should put on your passive hand first	66	54.1	56	45.9
	- The bonnet and surgical masks should be worn before surgical hand-washing	70	57.4	52	42.6

PPE: Personal protective equipment, SHW: Surgical hand-washing.

was examined, a statistically weak, negative ($r=-0.027$; $p=0.766$) relationship with PPE and a statistically significant, moderate, positive ($r=0.418$; $p=0.00$) relationship with SHW was found. A significant negative correlation was found between the total score and age (Table 5).

DISCUSSION

HAIs are preventable health problems which pose a major health risk, such as reduced quality of life, prolonged hospital stay, and even death. The biggest weapons which can be used to prevent HAIs are hand-washing and the usage of PPE.^{7,8}

As reported, 100% of the respondents had attended isolation method trainings. Consequently, 100% of the respondents had received trainings in the courses of their curriculum. In the study of Al-Rawajfah and Tubaishat⁴, 68% of students stated that they had received their training via their education curriculum. Nursing education plays an important role in improving the awareness of nursing students in preventing infection cross contamination.^{10,13}

In order to provide a successful health service, watches, rings, bracelets, false nails, etc. which carry the risk of infectious agents

must be removed by the healthcare professional before operations.¹⁶ In our study, 98.4% of the students responded correctly to the statement that “all jewelry should be removed before putting on PPE.” In the perioperative preparation process, the nurses should apply hand hygiene with the appropriate methods in order to prevent the transmission of pathogenic microorganisms in the hand-washing process so as to protect their own and their patient’s health.¹⁶ The student nurses answered the question “removing nail polish and artificial nails is important in surgical operations” correctly at a rate of 92.6%. Therefore, they support the principal that cleaning nail polish and removing artificial nails before operations prevents the transmission of infectious agents.

Regarding the item “PPEs should not be used only in the preparation of the operating room”, it was answered correctly by 96.7% of the students. Labrague et al.⁷ in their study stated that 93.1% of the students supported the statement that they “should wear protective equipment in all operations.” Amin et al.⁸ in their study reported that 38.6% of students stated that they “should only use the protective equipment when there is contact with blood.” When the literature were examined, it could be seen that the student nurses do not have enough knowledge about this subject.⁸ Gould and Drey¹⁸ reported that 53.6% of the students did not change their protective clothing during transitions between patients. This finding indicates the possibility of carrying infections between patients will continue and that protection cannot be provided.

Surgical masks prevent the transmission of infections from the respiratory tract (via the mouth and nose). For this reason, surgical masks should be placed covering the mouth, nose and chin.¹⁷ In our study, this item was answered correctly by 95.1% of the students. The metal part of the surgical masks should be placed on the bridge of

Table 3. Nursing Students’ Knowledge Average Scores PPE and SHW (n=122)

Sub-dimensions	Mean ± SD	Min.	Max.
Personal protective equipment	29.6±5.32	12.5	40.0
Surgical hand-washing	37.7±5.88	20	47
Total	67.4±9.44	40	85

PPE: Personal protective equipment, SHW: Surgical hand-washing, SD: Standard deviation, Min.: Minimum, Max.: Maximum.

Table 4. Compartments of PPE, SHW and Total Knowledge Scores of students’ by students’ characteristics (n=122)

Sub-dimensions		n	Mean ± SD	Min.	Max.	p
Personnel protective equipment	Female	83	30.2±5.17	17.5	40	0.150
	Male	39	28.5±5.52	12.5	37.5	
	Class 3	61	30.8±5.23	17.5	40	0.013
	Class 4	61	28.55.21	12.5	40	
Surgical hand washing	Female	83	38.6±5.25	22.5	47.5	0.027
	Male	39	35.7±6.69	20	45	
	Class 3	61	37.9±6.31	20	47.5	0.611
	Class 4	61	37.5±5.46	22.5	47.5	
Total	Female	83	68.8±8.79	45	85	0.022
	Male	39	64.2±10.1	40	82.5	
	Class 3	61	68.7±9.72	40	85	0.086
	Class 4	61	66.1±9.04	40	82.5	

PPE: Personal protective equipment, SHW: Surgical hand-washing, SD: Standard deviation, Min.: Minimum, Max.: Maximum.

Table 5. Nursing students’ correlations between age with PPE, SHW and total scores (n=122)

		Personal protective equipment	Surgical hand-washing	Total
Age	r	-0.027	0.418	-859
	p	0.766	0.00	0.00

PPE: Personal protective equipment, SHW: Surgical hand-washing

the nose.¹⁷ This item was answered correctly by 94.3% of the students. Ghalya and Ibrahim¹² stated that 98.9% of the students said that the use of protective equipment prevents the development of infections. Their finding gives almost the same results as in our study.

For effective hand hygiene, the health personnel must act with the principle of “first, do no harm.”¹⁶ The item of “Wash hands before and after all procedures” was answered correctly by 95.1% of the students. Garcia-Zapata et al.⁶ stated that all students washed before and after all procedures, Labrague et al.⁷ stated that 96.6% of students know that they should wash their hands before and after contact with patients. These high levels of results indicate that the students’ knowledge about hand hygiene is high.

According to the recommendations of AORN hand hygiene application steps, the process should start under the running water, and the hand-wash should start from the fingers and continue to clean under the fingernails.¹⁵ In our study, the item of “hand-washing should be carried out from the fingertips to the elbow” was answered correctly by 91.8% of the students. This result shows that the students had mastered this subject in their theoretical and laboratory trainings.

When removing the surgical mask, the bottom ties must first be undone in order to prevent contact with infectious agents on the front of the mask to the healthcare personnel.¹⁷ In our study, the item of “the upper ties of the surgical mask should be untied first” was answered significantly wrong by 86.9% of the students. It is thought that the student nurses may not have sufficient skills to use PPE and this finding might originate from this reason.

When tying the ties of the surgical masks, the upper ties should be tied first and then the lower ties.¹⁷ The item of “when tying the ties of the surgical masks, the upper ties should be tied first, and then the lower ties” was answered incorrectly by the 83 (68%) of the nursing department students.

Protective goggles are used to protect from splashing liquids.¹⁷ In the study conducted by Barikani and Afaghi¹⁹, the item of “goggles should be worn to protect the eyes” was answered correctly by 91.2% of the students. In our study, the item “protective goggles are removed with gloved hands to prevent contamination of the face” was answered incorrectly by 59.0% of the students.

The apron should be carefully grasped by the neck so as not to contaminate it from the back while putting it on.¹⁷ The item “a sterile apron should be put on by the wrist” was answered incorrectly by 67.2% of the nursing department students. Some priorities should be followed when taking off PPE. Removal follows the sequence of gloves first, followed by face protection or protective goggles, apron and mask, respectively.¹⁷ The item regarding this sequence (Sterile gown should be removed before removing sterile gloves) was answered incorrectly by 45.1% of the student nurses. In the study by Labrague et al.⁷ with nursing students, 100% of the students stated that the aim of taking standard measures (wearing glasses, masks, gloves, gowns) was to protect themselves and their patients, and 98.27% of them were wearing glasses, masks and gowns in order to prevent contamination of blood and body fluids.

In our study, female gender and 3rd grade students had higher information scores (38.6±5.25) on SHW than the male gender or fourth grade students. In a study conducted by Cruz and Bashtawi²⁰ with

nursing students, it was reported that male gender and lower grade students had higher levels of knowledge about hand hygiene than female gender and higher-grade students.

Study Limitations

This study was limited to nursing second grade and third grade university students at the university where the study was conducted.

Within the scope of surgical nursing of the nursing department of our university, the use of PPE and SHW procedures were explained both theoretically and in the basic skills laboratory and applied with the students.

CONCLUSION

Determining the imperfect knowledge about PPE and hand-washing procedures and taking measures, updating and evaluating studies on this subject matter, planning and coordinating training programs about any detected deficiencies by using current guidelines and conducting further research on these issues are recommended.

MAIN POINTS

- Despite the majority of student nurses graduating from standard high schools, they exhibit a moderate level of knowledge regarding personal protective equipment (PPE) and surgical hand-washing (SHW).
- Although all students have received education on isolation methods in their curriculum, their knowledge levels on PPE and SHW vary.
- There are no significant differences in knowledge levels between genders and class levels; students demonstrate similar levels of understanding on PPE and SHW.
- The moderate correlation found between knowledge levels on PPE and SHW suggests an interconnectedness between these two topics, indicating they influence each other.
- The study implies a need for greater emphasis on PPE and SHW within nursing education programs, as these areas are crucial in preventing healthcare-associated infections.

ETHICS

Ethics Committee Approval: Permission was received from the Scientific Research Publication Ethics Committee, Health Ethics Subcommittee with the project number (approval number: ETK00-2019-0012) as well as from the Eastern Mediterranean University.

Informed Consent: Voluntary informed consent form was obtained from the students in writing.

Authorship Contributions

Concept: K.Y., Design: K.Y., Supervision: K.Y., Fundings: K.Y., Materials: K.Y., T.A., F.T., Data Collection and/or Processing: K.Y., T.A., F.T., Analysis and/or Interpretation: K.Y., T.A., F.T., Literature Search: K.Y., T.A., F.T., Writing: K.Y., T.A., F.T., Critical Reviews: K.Y., T.A., F.T.

DISCLOSURES

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